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PAST AND FUTURE ADAPTATION PATHWAYS

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Abstract

Adaptation pathways are increasingly being used as a foresight tool to help guide the implementation of climate change adaptation and deliberate transformation. This paper applies a pathways lens as a hindsight tool to provide new understanding about past change and adaptation relevant for improving future adaptation pathways approaches. Four case studies of past adaptations to change are examined: Solomon Islands communities, Canadian forest-dependent communities, a Transylvanian village, and responses to climate adaptation policies in Australia. The results highlight that responses to change in these diverse case studies: involve complex transitions that gradually create new conditions and trajectories; manifest as multiple but inter-related pathways of change and response at different social or spatial scales (e.g. different paths for different households or communities); have legacies and continuities across time that affect future pathways of change; are affected by power in complex ways; and can create further change and need for adaptation. Analyses also highlight that when working with prospective adaptation approaches as a response to climate change there is a need to consider: (1) underlying assumptions, values and principles associated with the future; (2) the existence of interconnected multiple pathways and their implications for reinforcing existing social inequalities; and (3) how understanding past change provides inspiration for new and transformative futures. Overall, the paper concludes that shifts towards analyses for change rather than simply about change, such as adaptation pathways, will require more careful consideration of underlying ontological assumptions about the relationships between past, present and future.

Keywords

Adaptation pathways, adaptation, trajectories of change, time, climate change, futures, hindsight, foresight

1 Introduction

Rapid population growth, climate change, globalisation, and associated use of natural resources are creating major global challenges and are increasing rather than abating (Coumou and Rahmstorf, 2012; Godfray et al., 2010; Rockstrom et al., 2009). Critically, the rate of global change is also accelerating, with exponential growth occurring in diverse measures from land use, energy and technological and social change (Steffen et al., 2004). The speed and extent of change, which are often novel, unprecedented and systemic in nature, implies a need for greater flexibility and adaptability (Eriksen et al., 2011; Fazey et al., 2007) and radically approaches to decision-making (Miller, 2010). Importantly, new ways of thinking are needed about change itself and how it can be navigated in an era where change is rapid, increasing and is the norm (Miller, 2011; O'Brien, 2013).

Over the last two decades there has been considerable interest in understanding how people adapt to climate change and how to create transitions towards more resilient or sustainable futures (Bassett and Fogelman, 2013; O'Brien, 2012; Pelling, 2011). Emphasis is increasing towards analyses for deliberate change to address the challenges of climate change rather than simply about analyses of how change has occurred in the past (Berrang-Ford et al., 2011; O'Brien, 2012). This includes growing interest in future oriented analyses, including how back-casting and scenario planning can be used to harness social agency (Carlsson-Kanyama et al., 2013; Eames and Egmore, 2011; Tschakert et al., 2014; Wangel, 2011), and how these approaches can be enhanced by deeper understanding of past responses to change and historical social structures (Wangel, 2011).

A recent and relatively new approach to future oriented analyses is conceptualising adaptation as pathways or route maps to assist planning, implementation, and adaptation to climate change (Haasnoot et al., 2013; Reeder and Ranger, 2011b). While various and similar concepts have been used to understand and project the dynamics in development and environment contexts over time (e.g. Hagerman et al., 2010; Leach et al., 2010; Offermans and Cörvers, 2012), these earlier adaptation pathways approaches specifically aimed to incorporate longer-term temporal uncertainties and complexities into forward planning and action for adaptation to climate change. More recently, others have emphasised the need for broadening the perspective and application of adaptation pathways to better consider situations where goals are ambiguous, power is distributed, and path dependencies are pervasive (Câmpeanu and Fazey, 2014; Wise et al., 2014). Nevertheless, while the need to broaden out perspectives on adaptation pathways have been emphasised, many important questions remain about the processes that affect how different pathways emerge and how this informs approaches for aimed at implementing new adaptation pathways.

This paper therefore analyses past adaptation to provide new insights about how future oriented adaptation pathways might be approached. The paper first outlines key components of using a pathways lens to understand responses to change. It then explains how this has

been applied to four case studies in the Solomon Islands, Canada, Romania, and Australia. Finally, it discusses the key insights emerging from these studies about change and response dynamics relevant to understanding adaptation pathways in relation to climate and development. The paper is a direct response to calls for increased focus on understanding change processes (O'Brien, 2012) and thus takes a more holistic approach to understand how people respond to diverse forms of change, including social, economic and political change in addition to environmental change. Thus while the case studies are not always specifically about climate change, they represent a broader perspective that is necessary in order to better understand the relationship between environmental change and other forms of change, including processes of development. Overall, the paper will have wide relevance to academics and practitioners trying to understand how to navigate existing and future challenges of increasing social and environmental global change.

1.1 A pathways approach to adaptation in practice and as a lens for researching adaptation and change

Adaptation has received growing attention through academia, governments and international organisations such as the Intergovernmental Panel on Climate Change (Bassett and Fogelman, 2013). Adaptation is a human social, economic and political process that generally aims to reduce vulnerability and enhance resilience to change (Adger, 2006; Bassett and Fogelman, 2013). It can occur through adjustments to new conditions (e.g. changing agricultural practices when facing increasing drought); reforms that seek to alter problems by working within the existing system (e.g. dealing with poverty through changes in regulations and economic reform); or more extensive transformations that make fundamental changes to underlying political and economic structures (e.g. major regime change)(Bassett and Fogelman, 2013; Pelling, 2011). While there are many challenges to implementing adaptation (Berrang-Ford et al., 2011; Brown, 2011; Thomsen et al., 2012), there is growing interest in more holistic conceptualisations of adaptation that are normalised and mainstreamed in policy, planning and development (Dovers and Hezri, 2010; Leach et al., 2010).

The challenges of implementing and mainstreaming adaptation have partly led to the development of the concept of adaptation pathways, which views adaptation as a process rather than simply as abrupt events separate from social and political processes (Haasnoot et al., 2013; Wise et al., 2014). Adaptation pathways views adaptation as occurring through linear time, where key decision and intervention points are identified to help navigate and influence the direction of change (Figure 1). Originally introduced as a metaphor to help visualise and support decision-centred approaches to adaptation, adaptation pathways explore how different sets of possible actions can be sequenced through time to achieve overall, more desirable outcomes where achieving change is complex and uncertain.

Initially, pathways approaches focused solely on the uncertainty in knowledge required to develop such a sequence of actions and events (see for e.g., Haasnoot et al., 2013; Haasnoot et al., 2012; Reeder and Ranger, 2011a; Yohe and Leichenko, 2010). This approach aimed to inform risk-based approaches to decision making in reliable contexts where the decision process is centralised and the goals are clearly defined and uncontested. It has since been adapted to contexts where knowledge is uncertain, where there are multiple distributed

decision makers, and goals are contested, such as in biodiversity conservation, natural resource management, and coastal development (Downing, 2012; Haasnoot et al., 2013; Wise et al., 2014). The pathways approach in these contexts considers how available resources limit scope for different adaptation pathways and frame adaptation as both a decision-making problem and as a societal change process (figure 1, Wise et al., 2014) . This involves understanding how co-evolving knowledge, values, rules and norms define the social context of an adaptation issue and how different pathways might emerge (Gorddard et al., 2012).

Adaptation pathways are therefore approaches for planning and the identification of different adaptation options and how they can be realised. The context and social influences on those pathways are examined and the necessary societal changes needed to enable a shift in the direction of a particular pathway are explored. Yet, viewing adaptation as pathways is not only a tool for practice. It can also act as a lens for understanding how pathways of change have occurred in the past in order to provide deeper understanding of how people respond to change. Where adaptation pathways are prospective and used as a foresight tool to help navigate the future, a pathways lens is a retrospective tool to gain insights for the present and to help anticipate future trajectories and responses to change. In this paper a pathways lens is used in four case studies to understand how change has unfolded to help inform how future adaptation pathways might be conceptualised and approached.

2 Methods

2.1 Pathways lens

A pathways lens can be considered to be an approach to frame understanding of past change and response dynamics. It focuses on understanding how and why change and responses may have occurred, the different ways different groups have perceived, responded to or navigated change, contextual issues (e.g. politics, social norms, values) that affect change dynamics and the role of power in shaping change and human agency. This then provides more general insights about how responses to change might occur. While there are many examples of approaches that have examined change in development and environmental contexts (e.g. Hagerman et al., 2010; Hegmon et al., 2008; Orlove, 2005; Van Der Brugge et al., 2005), in this paper, the case studies are examined through a pathways lens that focuses on the relationship between three elements: (1) The dynamics of change and response; (2) The conceptualisation of change as unfolding linearly through time; and (3) the context in which change occurs, including the role of power.

First, change and adaptation is viewed as a dynamic, ubiquitous and constantly occurring through time rather than as specific interventions, distinct moments, or barriers to change. Viewing adaptation as an unfolding process focuses attention to the identification of patterns that explain how and why change occurs and how this results in particular outcomes (e.g. Ballu et al., 2011; Van Der Brugge et al., 2005).

Second, the case studies have been examined in relation to how change emerges through time, including linking the past with current dynamics and future trajectories. Temporal aspects are used in different ways in adaptation or vulnerability studies. Reconstructions of longer periods of societal change using archaeological data have been used to identify change

processes, such as those determining the severity of the impacts of change (Hegmon et al., 2008); historical events used as analogues to consider how adaptation is likely to occur in the future (Ford et al., 2010) such as analyses of the American dustbowl to understand likely adaptation to future anticipated drought from climate change (McLeman et al., 2013); longitudinal studies for detailed analysis of the challenges faced by those trying to adapt to change (Ford et al., 2013); and studies of path dependencies that lead to lock in or poverty traps (Allison and Hobbs, 2004; Anderies et al., 2006). In this paper, the pathways lens focuses on the existence of multiple possible paths occurring at the same time. These may, for example, be different households within communities that follow different adaptive paths, or communities within a region that have different trajectories (Câmpeanu and Fazey, 2014). In this way the pathways lens aims to understand the actual, but different routes taken in the past by different social groups (e.g. households, communities). This is different from the adaptation pathways approach which views different pathways as possible routes in the future, with different social groups choosing different decision pathways from the set of perceived available options (Haasnoot et al., 2013; Leach et al., 2010) and from many past approaches that have tended to focus on generalised patterns of a locality or region (e.g. Anderies et al., 2006).

Finally, a pathways lens considers how the context in which change and adaptation occur shapes change dynamics, including the role of power. This implies consideration of the wider ‘space’ in which paths unfold including the social, political and economic context operating at different but interrelated scales. The importance of context and scales is well recognised (Adger and Vincent, 2005; Eakin et al., 2009), with diverse methods for conceptualising these relationships, such as by using multi-level perspectives (Fratini et al., 2012; Geels, 2011). More specifically, while having received considerable attention in the development literature (e.g. Bowles and Gintis, 1993; Kapoor, 2002), the role of power has received relatively little direct attention in research on adaptation, resilience and vulnerability (Davidson, 2013; Hatt, 2012; Tschakert, 2007). While there are many conceptualisations of power in social theory, they all generally refer to the various means by which individuals and groups act in specific ways and their implications for human agency (Avelino and Rotmans, 2009; Gaventa, 1980; Hatt, 2012; Valorinta et al., 2011). In this paper, understanding the role of power is considered important for unravelling the dynamics of change.

2.2 Case studies

The pathways lens was implicitly or explicitly used to frame research in four case studies to help identify new insights about adaptation to change. While case studies are generally useful for providing comparative rigour (Ford et al., 2010), they can also be used to draw out new insights (Baumgärtner et al., 2008). The case studies have therefore been chosen to draw out such insights by covering diverse contexts (e.g. rural subsistence communities to communities in countries with developed economies); forms of change (e.g. political, economic and environmental); scales (socio-ethnic, communities, regions) and time frames (three to seventy years) (Table 1). All of the case studies are based on detailed research that broadly applied the key ontological foundations of a pathways lens described above.

In these case studies researchers generally took epistemological positions that acknowledge the subjective experience of the participants whilst also recognising a degree of causality

between responses to change and the way certain actions or outcomes are reinforced. This position is perhaps most similar to critical realism that acknowledges human agents as active mediators of social structures, existence of an observable reality (e.g. physical objects) but that processes of change are socially constructed and interpreted through discourse (McLaughlin, 2011; McLaughlin and Dietz, 2008). Such positions view social structures as realities that can be modified and sustained by agents (people) who reflexively acknowledge and deliberate the relevance or importance of those structures and culture to either maintain or transform them (Archer, 1995; Archer, 2010). This epistemological position has led to the use of qualitative methods involving combinations of ethnography, interviews, focus groups and facilitated workshops. Each of the case studies is explained below, with summaries of key findings for each case study outlined in Tables 2 and 3.

3 Results

3.1 Case Study 1: Responses to Environmental Change in Solomon Island Communities

Recent studies have examined past pathways and existing trajectories of change of 38 communities in Kahua, a remote region of the Solomon Islands, to social and environmental change (Fazey et al., 2010b; Fazey et al., 2011). Most people are dependent on subsistence livelihoods and there is little infrastructure (no roads or electricity), few opportunities for income generation (Allen et al., 2006), a rapidly growing human population (Fazey et al., 2011) and significant environmental change due to local human activity (Garonna et al., 2009; Kenter et al., 2011b). The approach taken in these studies was largely inductive and used extensive community engagement, large numbers of focus groups and interviews, and structured multi-tiered mechanisms that capitalised on the many learning opportunities provided by the participatory research (Fazey et al., 2010b). It examined changes occurring over 15-20 years in 38 communities and included development of a simple model of key feedbacks operating in the social-ecological system (Figure 2) to anticipate future change and provide a description of the overall pathway of change emerging from the actions of individual communities.

The model (Figure 2) highlights that stress in communities is largely driven by increasing population pressure on ecological systems and declines in subsistence resources. The primary response to this stress is to generate income through planting cash crops. Cash cropping often displaces food gardens from the most fertile areas, adding to pressure on ecological systems, reinforcing stress. Desire to make money is also driven by strong intrinsic desire for monetary prosperity, while increasing income increases the money in communities, raising expectations for material wealth and reinforcing desire. This is also influenced by neoliberal aid projects that encourage income generation. While money in communities has variable impacts, it is also eroding social cohesion and trust, making it more difficult for people to manage resources and disputes. The underlying dynamics of change and response are therefore generating trajectories that fail to address underlying causes and continue to threaten the subsistence resource base and social cohesion (Fazey et al., 2011). Local people

are also experiencing an acceleration of change, partly due to the changes created by increasing numbers of people and their attempts to deal with and respond to change.

The strong desire for monetary wealth and the need to reduce stress which drove income generation can partly be explained by the epistemological and cosmological views of local people. For example, in Melanesia there are often strong beliefs that commodities originate from ancestral sources and that time is not linear. These perspectives lead to the possibility for abrupt change to occur, partly explaining the high expectations that interventions (e.g. development) will rapidly lead to material affluence (Lindstrom, 1993). The dynamics were also heavily influenced by two powerful competing social attractors. These were normative pathways that privileged individualism and wealth generation versus the need to maintain collective cultural processes and social cohesion. The normative pathways reinforced inequality in communities, with the emergence of some families that were much more able to accumulate financial assets and engage and respond more effectively in markets, education, and employment, and other families that were increasingly being locked into poverty as they were less able to navigate the challenges posed by dwindling resources (Davies et al., Under review; Davies et al., 2014).

Overall, the case study highlights that: (1) Past change dynamics are creating future change and trajectories in different ways for different groups of people; (2) change and responses can accelerate further change; (3) values and preferences (e.g. desire for monetary prosperity) shape change and can be reinforced by responses; (4) development projects that are not sensitive to trajectories can contribute to unsustainable longer term maladaptive outcomes; and (5) that how time or change is conceptualised has significant impacts on responses to change and approaches to adaptation. Focusing on past change and future trajectories therefore provides a much broader examination of the context that shaped and created change, and how people were responding and trying to adapt to it.

3.2 Case Study 2: Responses to Loss of Employment in Canadian Wood Mills

This case-study examined patterns of responses to changes in two Canadian communities dependent on wood mills (Fort St. James and Youbou) in rural British Columbia. Closure of the mills in these communities and subsequent social and economic upheaval has led to different responses and pathways at community, household, and individual scales (Lyon, In Press; Lyon and Parkins, 2013). At local levels the Youbou community had a stronger cultural affiliation with the mill (e.g. evidenced through labour activism and mill-inspired community groups). The community had rallied to contest the closure and more than a decade later feelings of despondency and being let down were very evident, with less willingness to accept change and find new identities. In Fort St. James, mills played a more subordinate cultural role to the community itself, with less activism than at Youbou and greater willingness and capacity to seek alternatives. These differences can be explained by historical development of the communities: Youbou emerged over a century as a dedicated mill-town in an area of strong historical labour activism while Fort St. James originated 200 years ago as a fur trade post and Nak'azdli aboriginal settlement, before moving into mining, and then forestry, and now potentially mining again with the construction of a nearby goldmine.

Different pathways also emerged for household levels. Household gender dynamics have tended to be typified by coupled heterosexual relationships, with men mostly employed in the main industry (e.g. mill, fishery, mine) and women performing as housewives and possibly having secondary employment. This norm appeared to have remained relatively unchanged over multiple generations until closure of the mills. Men's occupation and breadwinner roles were closely linked with their personal identity, with permanent loss of the mills resulting in responses which, in keeping with other studies (Davis, 1993; Sherman, 2009), increased household conflict, substance abuse, or self-destructive behaviour, placing additional caregiver burdens on women partners and other family members (Lyon, 2014). In some cases in Fort St. James, however, gendered relationships improved as some men for the first time took on household tasks normally adopted by women. This resulted in a more equitable sharing of chores with their partners, indicating an adaptive strategy that deviated from the well-established usual historical pathway of gender roles.

At individual levels, different pathways also emerged. Closures had not been anticipated despite industry-wide trends with the shock of the closure stimulating a process of 'coming-to-terms' with the change. This included a difficult process beginning with shock or surprise, a loss of what to do, and then finally setting about constructing new identities and livelihoods as they came to terms with their new reality. This process appeared readily in comments from social services workers and spouses, and echoed those observed by Cox and Perry's (2011) individual disorientation-reorientation and Davis and Reed's (2013) group oriented awareness, critical reflection, and transformative action process of adaptive responses to crises.

In general, the case study highlights that: (1) even when change appears to be abrupt, it is important to view adaptation or transformation as a more continual process with historical legacies and continuities and complex cultural, social and economic influences; (2) there are intertwined pathways of different actors and factors (i.e. gender, history) that influence each other; (3) these pathways operate at different social scales (individual, household, community); and that (4) examination of the unfolding different past pathways can highlight positive outcomes (e.g. for gender relations).

3.3 Case Study 3: Responses to Political, Social and Economic Change in a Transylvanian Village, Romania

This ethnographic case study analysed change and responses of different socio-ethnic groups in a small multi-ethnic rural Transylvanian village (Mălâncrav) over 70 years. This included examining how different socio-ethnic groups responded to change through time and the interdependencies of the different pathways taken by different socio-ethnic groups (Câmpeanu and Fazey, 2014). Emphasis was placed on understanding the subjective experience of different community members and how responses were socially patterned and the trajectories in which these responses were embedded.

Mălâncrav has undergone dramatic changes in the past 65 years: the 1945 Agrarian Reform, collectivisation, the 1989 regime change and land restitution/redistribution, and Romania's accession to the EU (Poledna, 1988; Șandru, 2000). These changes were experienced locally as transformations in access to and the nature of available livelihoods, and implicitly in the

factors that shaped patterns of land use at both household and community levels. Most people in Mălâncrav now rely on a combination of subsistence agriculture and involvement in cash making activities (including temporary labour migration) for their livelihoods. The study found that the community was structured by hierarchies and dynamics connected to ethnicity and length of residence in the village which affected the degree to which they were integrated in social and political dynamics of the village. Five socio-ethnic groupings were identified, including newly arrived and longer resident Romanians, Saxons, and newly arrived and longer resident Roma.

People responded to the historical changes in ways patterned by the socio-ethnic group to which they belonged through different but inter-related pathways through time. Responses to change were influenced by group-specific opportunities and constraints and by the assets and resources these groups were able to mobilize (e.g. land, intra-group social capital, inter-group social capital, ethnic and symbolic capital, political capital, cash inflow, formal education and agricultural knowledge). For example, Figure 3 represents changes in the assets of two of the socio-ethnic groups: the Saxons and more established Romanians. Despite loss of almost all of their land in the post war period, the Saxons were able to transcend this difficult period by relying on their political capital which was partly symbolic because of how they were seen by others because of their ethnicity (they had originally had significant control in the community) and on their education, which enabled them to find work outside of the village. When farms were collectivised, this gave them opportunities to reintegrate with subsistence activities.

The case study revealed important underlying social dynamics around the inter-related pathways. First, socially-patterned pathways emerged in relation to a strong normative pathway of responses to change, which was shaped by practices and options for subsistence agriculture and cash making activities. Second, the normative pathway socially and symbolically validated the strategies and practices of the better-positioned groups (e.g. the Saxons and more established Romanians) which were more able to follow that pathway. It also de-valued those of the marginal groups (the more recently arrived and longer resident Roma) which were less able to follow the normative pathway because, for example, they had limited access to land, although they were innovatively finding other ways to cope. Third, while assets and resources enabled creative and diverse responses to diverse changes, the pathways were still shaped by legacies of what had worked in the past. That is, accumulation of particular assets and resources motivated action because, in the collective memory of past experiences, such actions were successful in maintaining or raising social position. The dynamics of change and response in the community were therefore shaped by historical power dynamics in the form of a strong normative pathway which was reinforced by the adaptive responses of different socio-ethnic groups.

3.4 Case Study 4: Responses to policies for adapting to sea-level rise in Australia

This case study analysed responses to proactive and deliberate change which occurred in the form of adaptation policies instigated in 2010 by the Eurobodalla Shire Council in New South Wales, Australia to deal with sea level rise in a community where beaches, dunes and

estuaries at threat of ‘coastal squeeze’ were highly valued in both absolute and relative terms. Australia’s social, political and economic systems that largely privilege free-market capitalism, and modernism, mean that responses to environmental change reinforce the control and resistance to change and the protection of private instead of public interests (Thomsen et al., 2012). The sea-level-rise policy for the Shire’s 130 km coastline aimed to manage the long-term increasing risks of inundation to private and public infrastructural and natural assets. The policy aimed to protect the most (economically) important infrastructure (e.g. the harbour and central business district of the town) while promoting managed retreat in areas with lower population densities, economic consequences and higher environmental values. The policy was informed by the latest scientific understanding and model projections of climate change and the changing risk profile of inundation of ecosystems and low-lying houses, roads and sewerage infrastructure. It was also informed by advice that the council could potentially be legally liable if it did not act in the best interests of the community.

Despite these considerations stakeholder responses to the final adoption of the interim policy were highly polarised (Gorrdard et al., 2012). Those indirectly affected by the policy were set back from the beachfront and were generally silent but supportive because one of the policy’s intents was to protect coastal ecosystems (i.e. beaches and dunes). A small minority of politically connected beachfront property owners and developers felt the policy violated their rights and unfairly imposed costs on them, and became vocal and openly hostile toward the council. This resulted in increased distrust and disharmony between community groups and the Council. Subsequent to these events, a newly elected State government undermined the Council’s interim sea level rise policy by allowing property owners to install temporary protection works without prior approval.

Vested interests were found to be extremely prevalent and influential in responses to the policy, particularly those of developers and private property owners in and around the region and distant investors and shareholders in companies benefiting from the existing regulations, land-use entitlements and development zones. These interests often conflated and enflamed existing contested values about how to respond to threats to public and private assets (Gorrdard et al., 2012) and were enabled through powerful support from the media (McKnight, 2012). Moreover, the existing coastal planning system – due to its evolved and complex state – was insufficiently flexible or integrated to allow Council planners to develop the novel responses required to effectively and fairly address the property rights, liability and compensation issues at the heart of a retreat policy (Abel et al., 2011). Critical governance barriers included the absence of any Commonwealth powers in these coastal areas and lack of clarity in the roles and responsibilities of the State and Local Governments (Gibbs and Hill, 2011; Thom, 2013).

In general, the case study highlights that there were: (1) multiple framings of the issues and problems along the coast (reflecting diverse values, interest, and beliefs) that resulted in multiple contested pathways being promoted (e.g. many coastal developers and beachfront property owners rejected the science and policy responses due their vested interests in maintaining the status quo versus the indirectly affected public concern with the permanent loss of coastal natural assets); (2) different and incompatible social and environmental pathways largely dictated by the differences in their dynamics, with the former being relatively static due to slowly-changing institutions and the latter characterised by rapid

coastal erosion and sea level rise; and (3) numerous legacy effects and path dependencies that exist in the research and decision-making processes which were used to deal with the problems of coastal inundation which were largely inadequate for dealing with the novelty of many of the aspects of the climate-induced changes.

4 Discussion

4.1 Implications for understanding adaptation and change

4.1.1 Dynamics of change

The case studies broadly show how decisions and actions in response to social, ecological, and economic events are themselves ongoing and continuous processes of change (Figure 4). While environmental issues were a key aspect of the case studies, in the majority of cases responses centred on people's perceptions of social, political or economic issues. While there may be specific change events or moments (e.g. closure of wood mills), change was more generally experienced and negotiated through the realities of everyday life and the memory of the lives already lived. This is because change, or the kind of changes that occur most frequently, is continuous and over time rather than as abrupt environmental or social events. 'Adaptation' therefore also occurs continuously on a daily basis as a process of complex transitions that gradually create new conditions and trajectories. Further, the case studies highlight that change and adaptation is experienced and shaped in relation to deeply-held human needs and details of daily life (Horton, 2002) and that some kinds of change that require responses may be given greater precedence than others (Tschakert et al., 2014). This has important implications for how adaptation actions in response to climate change might be approached. For example, vulnerability or adaptation assessments that fail to identify the immediate and most pressing aspects of change that people are responding to are likely to result in erroneous interpretations of how people are likely to respond to change in the future, including change that occurs through implementing climate change policies.

4.1.2 Interdependent multiple pathways

The case studies demonstrated that diverse and interdependent pathways of change and/or responses operate at different social or spatial scales (Table 2). These included different paths operating concurrently at regional scales (e.g. different values, worldviews or attitudes), at the scale of communities (e.g. communities with different socio-economic trajectories), socio-ethnic groups within communities, level of the household or individuals (e.g. gender roles and relations) and for the different kinds of assets available to particular groups (Table 4). These concurrent paths helped explain why responses were occurring in particular ways. In Transylvania, for example, the newly arrived Roma who were not well established in the community and had limited access to land were adapting to their circumstances in innovative ways, but not in ways that were the norm for the community. Their inability to engage in 'normal' practices because they lacked certain assets prevented them from gaining important political capital, integrating into village life in ways that favoured asset accumulation, and achieving social mobility (Câmpeanu and Fazey, 2014).

Conventional approaches to vulnerability analysis have been heavily criticised for obscuring underlying inequalities and masking the underlying dynamic structures that contribute to such inequalities (Cuomo, 2011; Tschakert et al., 2013). The Transylvanian case shows how a pathways lens can overcome some of these criticisms to both better understand the origins of present conditions and inform thinking about the potential implications of adaptation measures that may reinforce or reduce inequalities. The Australian case study also highlights that the process in which adaptation is implemented (e.g. whether the process is perceived to be fair, just, legitimate or wise) is also critical for the way in which adaptation is realised. Nevertheless, the pathways lens also identified positive outcomes of change that can also be masked without deeper understanding of the inter-relationships between pathways of response, such as for gender relations in the Canadian case study (Lyon, 2014). Overall, understanding the past hidden inequalities provides important insights for the kinds of issues that need to be considered, anticipated or managed more effectively when trying to implement future oriented adaptation pathways.

4.1.3 Legacies and continuities

All of the case studies demonstrated there were important legacies and continuities that shaped changes and responses, even when those changes were significant and relatively abrupt. The legacies and continuities varied depending on the focus and context of the study (Table 3). Continuities included aspects such as worldviews, values, culture, power relations, availability of key assets, and the normative goals or perspectives of what constituted ‘successful’ adaptation (Tables 2 and 3). These had significant influence in shaping the contexts in which events were experienced and the nature of the responses to change. For example, in Australia legacies of a culture of compensation, mechanistic worldviews and favourable attitudes to private property rights created a context where it was then possible for a minority to have considerable influence on the nature of the response to the change (in this case the new local adaptation policy). The effectiveness of resistance to change was not surprising given that change always disturbs already well-established interests (Meadowcroft, 2011) and that there are always strong attractors towards maintaining ‘business as usual’ practices (Bussey et al., 2012). Nevertheless, it suggests that when analysing past responses to change, paying attention to the continuities, legacies, and transitions which shape how people respond to change is probably more important than privileging the moments and processes of disruption and abrupt transformation. While key moments of change do exist and provide windows of opportunity to help shape new pathways, they will still be influenced by longer term factors that transcend shorter term periods of change.

Some of the most important continuities in the case studies were variables operating over relatively long time frames, such as culture, worldviews and values (Lyon and Parkins, 2013; Tibbs, 2011). These ‘slow’ variables have significant implications in shaping resilience, vulnerability and future responses to change and are difficult to change (Crépin, 2007; Walker et al., 2012). Nevertheless, while these variables may remain the same over long time periods, they are not static and unchanging (Archer, 2010; Curry and Hodgson, 2008; Hanlon et al., 2011; Tibbs, 2011). This implies that applying adaptation pathways approaches need to consider how actions may reinforce, dampen, or disrupt certain ways of thinking and the role they play in shaping or inhibiting moves towards more adaptive or sustainable systems.

The case studies also showed that some legacies and continuities were latent, with key resources, characteristics and solutions remaining hidden and only mobilized or made visible in relation to particular contexts or events. This was apparent in Transylvania where the Saxon socio-ethnic group relied on their relatively high level of education to generate a livelihood outside of the community enabling them to transcend a particularly difficult period where they were denied access to land (Câmpeanu and Fazey, 2014). They then re-mobilised their latent but extensive agricultural knowledge and high level of ethnic symbolic capital when new and more favourable socio-political conditions re-emerged. Identifying these hidden assets can assist the leveraging of adaptation pathways, but to do so generally requires some form of historical analysis of adaptive capacity (Engle, 2011).

4.1.4 Context and power

In all cases, power was crucial to providing explanations for how change and response dynamics occurred (Table 3). Power can be broadly conceptualised in two different ways. First, it can be viewed as ‘power over others’, where individuals or groups may enhance or maintain their social status and thus have influence over others or access to resources. This kind of power can occur in three main dimensions: (a) the “visible” dimension including the “formal rules, structures, authorities, institutions and procedures of decision making” and how these constrain certain actions; (b) the way some groups are able to exert control over others (e.g. authority and how resources are controlled); and (c) people’s unconscious subscription to certain behaviours and modes of thinking (e.g. they may act and speak through ideological positions or psychological habits that prevent other ideas or ways of thinking) (Gaventa, 1980, 2005; Lukes, 2005). These dimensions were particularly apparent in the Australian case study where a minority of landholders and developers were able to influence key decisions through influencing processes and procedures, by having authority in the control of resources (e.g. ownership of beachfront property), and by having their voice validated by particular ideological societal views which privileged the free-market and modernism.

The second way in which power manifested was through normative pathways which validated the strategies and practices of those who were better positioned in society. This then affected how different discourses, and thus pathways of change or adaptation played out. This was apparent in the Solomon Islands where there were competing discourses around cash-cropping and the need to maintain social cohesion that shaped the uptake or impact of development interventions. In Transylvania, normative pathways also helped explain how some marginalised groups remained marginalised despite significant social and political change. In general, manifestation of power in these case studies was similar to the Gramscian power-inspired social attractor concept (Hatt, 2012). In this conceptualisation of power, social attractors are the phenomena around which discourses emerge and consent is organised for various social practices in a given context. These discourses and practices then lead to positive or negative feedbacks, or pathways, which shape the overall system of social-ecological relationships. In the Solomon Islands, for example, the attractor is the normalised pathway of valuing subsistence agriculture and social cohesion, while competing discourses are the practices of cash cropping and engaging in community activities shape the extent to

which the normative path and values are upheld. Discourses wax and wane, shaping the extent to which particular pathways and their environmental or social impacts emerge.

Overall, the case studies highlight that there can be hidden yet very significant manifestations of power that shape trajectories of change and which limit the capacity of adaptation pathways approaches to alter existing trajectories. Practical identification of power that may be present in an adaptation scenario, and how it operates, is therefore critical to the question of adaptive or maladaptive trajectories of change. Certain power issues can be difficult to surmount, yet ignoring them risks hampering future adaptation pathways approaches (Davidson, 2013; Tschakert, 2007; Tschakert et al., 2013).

4.1.5 Trajectories of change and response

The case studies also show how dynamics of change and response create trajectories that, in the absence of significant forces to change directions, are somewhat predetermined and conditioned by past responses to change. This was apparent in the Solomon Islands where responses to environmental change and associated stress in communities reinforced many of the underlying problems, and were fuelled by some forms of development interventions (Fazey et al., 2011; Kenter et al., 2011a). Such trajectories have important implications for resilience and future adaptive capacities (Adger et al., 2011; Fazey et al., 2010a). In the Canadian example, capacity to adapt to the loss of wood mills appeared higher in communities that historically had been exposed to greater amounts of change or had a plurality of socio-cultural focus points (Lyon and Parkins, 2013). This follows other studies that suggest that exposure to change or uncertainty can enhance dispositions or capacities for adaptability (Cliggett et al., 2007; Dreyer and Grønhaug, 2012; Fazey et al., 2007). Thus, findings from using the pathways lens emphasises that current actions create certain trajectories, but that these can have subtle impacts not only on the options available for future decisions, but also on the values, capacities, and dispositions for flexibly responding to future change.

One of these subtle effects was that adaptation creates further, and sometimes accelerated, change. This acceleration was most apparent in the Solomon Islands. Local people had few options other than to adapt to dwindling resources by planting cash crops, even though they recognised that their responses were creating new and fuelled existing problems, to which they then also had to adapt (Fazey et al., 2011). This acceleration is analogous to the Red Queen hypothesis in co-evolutionary biology (Brockhurst and Koskella, 2013) and Lewis Carroll's account where the Queen indicates that running ever faster is necessary to stay ahead of the game (Carroll, 2007). One of the negative effects of enhanced adaptive capacity or flexibility may therefore be that it reinforces change, which in turn requires more adaptive responses or flexibility, partly explaining acceleration of global change. More transformative forms of adaptation therefore require some way of stepping off the accelerating treadmill. This is precisely the aim of 'slow' movements, which recognise the challenges of modern living and purposely adopt slowness in order to find more sustainable alternative practices of work and leisure, family and social relations (Gess, 2012; Parkins, 2004; Steele, 2012).

4.2 Implications for future adaptation pathways

The analysis of past pathways has three main implications for future adaptation pathways. First, the case studies confirm conclusions by others (Gorddard et al., 2012) that responding to complex global change is both a decision problem and a long-term process of societal change. Responses in the short term to novel changes and impacts will generally be highly constrained, incremental and focused on proximate causes and issues due to inappropriate and inflexible rules, contested values and political vested interest. Thus, if research and decision processes are to lead to effective and just responses, then they need to inform how short-term incremental decisions can avoid closing off options and locking-in undesirable futures. They also need to develop better understanding of the co-evolution of the systems of knowledge, values and rules which surround critical decision processes and how to iteratively and adaptively influence these.

Second, the pathways lens helped explain how differences between social groups persist, how past responses to change shape current trajectories, and helped anticipate how future responses unfold. When designing adaptation strategies, results of using a pathways lens will therefore be most useful in problem analysis, identifying possible actions, and considering the likely effects of possible adaptation actions (Haasnoot et al., 2013). But the pathways lens also highlights how the choice of social scale represented by a future adaptation pathway may mask important underlying dynamics that can be influenced or reinforced by the way in which adaptation pathways are implemented. This implies that when developing adaptation pathways, careful consideration needs to be given to what or who a particular ‘pathway’ represents, and how different social groups may experience or perceive different adaptation pathways. Being more explicit about what we mean by the possible adaptive paths and the different manifestations of power in a particular adaptation context is therefore essential if more innovative and potentially more sustainable pathways are to emerge.

Third, considering past and future pathways raises important questions about the fundamental role of both approaches. The pathways lens provides hindsight to give insights in the present which can inform the development of adaptation pathways. Using the metaphor borrowed from Hodgson (2013), a pathways lens looks into the rear-view mirror, whereas the adaptation pathways approach tries to understand what the unfolding road could look like in front of the windscreen. Thus future adaptation pathways are not strictly a forecasting tool as they do not necessarily aim to predict the future. Instead, they are a tool to help shape future change. Actions are not only based on experience of the past, but also on how the future is both imagined and our ontological understanding of the ‘present’ and the ‘future’ (Hodgson, 2013). In the Solomon Islands case study, for example, change (e.g. economic development) was understood as something that could manifest rapidly and abruptly, and in ways different to the range of possibilities that might be imagined in Western views of change or development.

There are three aspects relating to understanding of time which affect our understanding of present, future, and what we consider to be possible in the future (Hodgson, 2013). These include: *Chronos*, or the experience of events as successive or the ‘flow’ of time; *Aionios*, which is the latency, pattern and the diverse potential available for a variety of actualizations; and *Hyparxis*, which refers to the commitment, freedom to choose, and imagination which

enables the potential to be tapped and the creation of new possibilities (Hodgson, 2013). In practical terms, the future does not exist out of the present, and given the complexity and uncertainty inherent in a future that has not yet happened, prediction is often not useful (Miller, 2010). More importantly, considering all three aspects relating to time and changing the way we think about what constitutes ‘future’ provides greater scope for freeing the mind from what is predictable and to enable space for embracing complexity and emergence and the invention of imaginary futures (Miller, 2011).

Adaptation pathways provide important opportunities for more innovative possibilities in a future that has yet to occur. Therefore, while historical thinking brings depth and inspiration to futures thinking (Bussey et al., 2012), perhaps the most important role of a retrospective pathways lens is to provide understanding about what we do or don’t want the future to look like. The possibility for improved gender relations in some households following closure of mills highlighted by an historical analysis (Lyon and Parkins, 2013) was not something that had previously been imagined. The past analysis of the Australian case study might also spark imagination for a new future where the powerful and vested interests of a minority do not adversely affect decisions and where those without a voice, such as the environment, are also heard. Provided past analyses do not constrain our thinking about what the future could include, such as through creating a sense of being hamstrung by perceived complexity, a pathways lens can provide both practical insights for adaptation pathways and inspiration for the creation of new futures.

5 Conclusions

The role and context of research is changing (Mauser et al., 2013). Societal demands are increasingly requiring research to demonstrate utility and address emerging and anticipated major global crises. Yet there is growing recognition amongst communities, businesses, and policy makers that the future is not as amenable to prediction as was once thought and that new approaches are needed for working with uncertainty and change. This paper has contributed to these issues by providing insights to understand change dynamics. It highlights that understanding how people respond to change is better done with a good dose of historical sensitivity, by placing responses in the context of longer trajectories of adaptation, and that these trajectories are influenced by legacies of social hierarchies, access to assets and resources, and the collective memory of different livelihood solutions and strategies. It also highlights that several, complex intertwined trajectories of change are likely to be occurring at the same social scale. These are the product of, and are implicated in, social, economic, and political processes.

The paper also highlights key issues that need to be considered when developing future adaptation pathway approaches to enhance resilience in the face of climate change. This includes the need to be cognisant of the influence of different factors, the relevance and timeliness of initiatives, and the multitude of actors and organisations that need to be involved if future approaches are to be successful. It also indicates the importance of viewing adaptation as a social process and to consider the diverse social relations and values, including accounting for the importance of power, and how responses to change reinforce or dampen existing relationships and inequalities. Strategic and iterative processes are therefore

needed to help navigate change, facilitate transformation and navigate the multiple, intertwined, political, and subjective pathways of different social groups. This requires better ways of working with a plurality of values, such as the ‘perspectives method’ (*sensu* Offermans et al., 2011) and long-term commitments rather than ‘hit and run’ project approaches. Finally, more sophisticated ways of conceptualising the relationship between past, present and future is required that can lead to inspiration and innovation for more deliberate approaches to transformation of existing pathways within the context of an increasingly complex, dynamic and uncertain world.

6 Acknowledgements

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Table and Figure Captions

Table 1: The approaches and methods used in the case studies

Table 2: Details of findings from the case studies

Table 3: Details of past historical legacies and future trajectories

Table 4: Examples of the different kinds of pathways in the case studies

Figure 1: The adaptation pathways concept represented in visual form of future possible routes and decisions for adaptation (modified from Wise et al., 2014). Current time is located towards the left of the diagram. Dark arrows represent different possible routes that could be taken, circle arrows decision points, grey arrows are pathways that would lead to maladaptive outcomes, and dashed blue arrows represent transformative pathways towards new trajectories (e.g. when a current pathway is identified as having an undesirable trajectory. For a more detailed explanation of adaptation pathways, including explanation of the context in which decisions are made, see (Wise et al., 2014).

Figure 2: A causal loop diagram (CLDs) of the key feedbacks operating in the Kahua social-ecological system (modified from Fazey et al., 2011). R and B refer to reinforcing and balancing feedback loops. Positive polarity on the arrows indicates that an increase or decrease in the previous variable will result in the same direction of change in the variable that the arrow points towards (e.g. when stress in communities decreases, the desire to make money decreases). A negative polarity shows that a change in a preceding variables results in an opposite direction of change in the next variable (e.g. when money in communities increases, social cohesion and trust decreases).

Figure 3: How different assets held or accessible to different socio-ethnic groups in a Transylvanian village changed over time and in relation to significant periods of change (modified from Câmpeanu and Fazey, 2014). The Y axis represents extent of assets held by a group where 3 = maximum amount held by any group and 0 = none assets held by a group. The graph shows how some assets (e.g. access to land) fluctuate, whereas others are more stable. It also highlights differences between socio-ethnic groups, reflecting different sub-paths of opportunities and resources held by these groups.

Figure 4: Representation of how pathways have unfolded through time in the case studies. The present is located towards the right of the diagram. The dark large arrow represents the actual dominant or normative pathway or trajectory (e.g. as highlighted in the Solomon Island and Transylvanian case study). Lighter shaded large arrows are possible paths that could, but were not taken. Darker, lines represent different routes taken by different groups at the same social scale (e.g. different communities, different socio-ethnic groups within a community) but which are located within a dominant pathway. Overall, even though some change may be abrupt, change and their responses which shape the pathways are usually part of a continual shifting dynamic. Change and responses identified through using a pathways lens approach therefore highlights the importance of understanding how these wider trajectories are shaped, and the way in which different groups are interrelated and influenced by each other, and how they maintain or give rise to inequalities.

Table 1

	Aim and types of change	Approach	Method	Data collection	Analysis
Trajectories of change in Solomon Island Communities	Identify how responses to growing population, reduction in subsistence resources, increasing stress in communities and neoliberal development policies influence vulnerability of remote communities.	<ul style="list-style-type: none"> Identifies changes and their causes over last 15 years; Anticipate future trajectories of change, adaptation and vulnerability; Uses a participatory and multi-tiered learning approach to encourage social learning. 	<ul style="list-style-type: none"> Ethnographic (4 months); Qualitative; Participatory; Building conceptual models of feedback in the social-ecological system (causal loop diagrams). 	<ul style="list-style-type: none"> Interviews (30); Focus groups (72); Participatory workshops (3); Ethnographic notes. 	<ul style="list-style-type: none"> Qualitative; Semi-quantitative; Development of formal conceptual models; Triangulation between interview, focus group and workshop data; Verification with local research assistants and communities.
Responses to change in Canadian Forest-dependent communities	To understand how communities cope with major economic change following loss of employment from Canadian wood mills.	<ul style="list-style-type: none"> Identifies how historical legacies inform present day local culture, place, and gendered social norms; Shows how these aspects condition adaptive responses to change over two decades. 	<ul style="list-style-type: none"> Ethnographic (3 months) Built frameworks to understand: Distinction between cultural and social system; How affective and physical place interact to shape social responses to change. 	<ul style="list-style-type: none"> Residency in two communities; Interviews, field-notes Participant observation of community activities; Literature reviews of books, papers, and relevant news media articles. 	<ul style="list-style-type: none"> Qualitative analysis of themes; Strong foundation and application of critical realist social theory; Development of conceptual models.
Responses to change in Transylvania	Determine how different socio-ethnic groupings adapt to major social, political and economic change over seven decades.	<ul style="list-style-type: none"> An inductive approach that identifies: <ul style="list-style-type: none"> Main events of change over last seven decades in a single village; Relevant social groupings How different socio-ethnic groups have responded to these changes over time. 	<ul style="list-style-type: none"> Ethnographic fieldwork (5 months); Inductive, qualitative. 	<ul style="list-style-type: none"> Formal interviews (34); Informal interviews; Participant observation; Household survey (all houses in community); Archival research in the local administration archives; Documentation through notes. 	<p>Reiterative process that identified:</p> <ol style="list-style-type: none"> 1. Main events and response patterns; 2. Social structures; 3. Opportunities and constraints, assets and resources over time; 4. Socially specific pathways of managing change.
Responses to changes induced by adaptation policies in	Understand how a coastal retreat policy for adaptation led to community	<ul style="list-style-type: none"> Ex-post analysis of a recent attempt to adapt coastal properties to changing inundation threats (over last 	<ul style="list-style-type: none"> Qualitative; Used the values-rules-knowledge (vrk) perspective on adaptation 	<ul style="list-style-type: none"> Critical and selective review of grey and peer-reviewed literature and media reports. 	<ul style="list-style-type: none"> Qualitative and higher-level analysis of the decision problem, decision process and decision context.

Australia	disharmony and undermining of the policy by the state government.	three years).	pathways to understand the framing and practice of adaptation.
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Table 2

	Dynamics of change and response	Existence of multiple, intertwined paths	Adaptation embedded in cultural, social, political and economic conditions
Trajectories of change in Solomon Island Communities	<ul style="list-style-type: none"> • Responses to environmental change and stress create more change and reinforce impacts on the environment; • Change and response dynamics are accelerating social and environmental change; • This acceleration is partly enabled by neoliberal approaches to development that focus mostly on income generation. 	<ul style="list-style-type: none"> • Changes and responses within communities and across gender were relatively homogeneous; • However, the overall trajectory was reinforcing existing inequalities, suggesting that related but different paths were becoming more distinct as different strategies for managing change were emerging; • Environmental pathway closely intertwined with social pathway. 	<ul style="list-style-type: none"> • Local (community) politics were very influential given lack of resources of the provincial government; • Ownership and use of land, which is the most important asset, is heavily intertwined by politics and power; • Cosmological understandings that do not view time as linear affected expectations of how development and adaptation pathways can occur.
Responses to change in Canadian Forest-dependent communities	<ul style="list-style-type: none"> • Responses to sudden change were influenced by historical and cultural legacies; • Some of these legacies endured (e.g. culture) and some were transformed (e.g. gender roles) over time; • Historical and cultural legacies formed around key social attractors. 	<ul style="list-style-type: none"> • Overall patterns and pathways were made up of different individual, household, community and cultural trajectories; • Untangling the different actors and factors in each pathway revealed positive outcomes (e.g. for gender relations) despite seemingly negative periods of change. 	<ul style="list-style-type: none"> • Social structures (culture, place, gender) enabled and constrained social adaptation; • Historical legacies and culture were reoriented toward adaptation to change; • Recognition and transformation of some but not other conditions was possible. • Inability to recognize or address some conditions resulted in maladaptive trajectories.
Responses to change in Transylvania	<ul style="list-style-type: none"> • The way different socio-ethnic groups responded to change depended on the opportunities and constraints change created for each group; • Responses were also influenced by the assets and resources each group could draw on. • The assets of each group fluctuated over time and in response to change; • Some of the assets (e.g. education and symbolic political capital) enabled some groups to transcend periods of major change allowing them to recover rapidly when more favourable conditions re-emerged. 	<ul style="list-style-type: none"> • Different socio-ethnic groups have different, but interconnected paths based on the opportunities and constraints connected to the changes that are experienced; • These paths have different social values corresponding to existing social hierarchies and dynamics; • The path of the better-situated group emerges as the normative or dominant one by which the 'success' or 'validity' of other approaches are judged. 	<ul style="list-style-type: none"> • Social political and economic changes are key drivers but these provide new opportunities and challenges for different groups; • Adaptation and responses to change are first and foremost social processes of transformation, embedded in the social and economic contexts at different levels (local as well as regional and national).
Responses to adaptation	<ul style="list-style-type: none"> • Individuals with certain knowledge and worldviews were drove dominant responses to change. 	<ul style="list-style-type: none"> • Multiple paths of ecosystem and social systems: Coastal ecosystems are highly 	<ul style="list-style-type: none"> • Shifting baselines and the tendency to accept the status quo are two powerful

policies in Australia	<ul style="list-style-type: none"> The many stakeholders set back from the beach, along with the rest of Australian society who value the public amenity and existence values of the beaches, dunes and estuaries at threat of inundation, were marginalized from the decision processes and had limited opportunity and mechanisms to influence outcomes. 	<p>dynamic and shifting landwards yet coastal social communities live in highly static and resistant built environments.</p> <ul style="list-style-type: none"> Multiple paths of values and knowledge. 	cultural, political and social factors leading to responses being incremental and maladaptive.
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Table 3:

	Importance of Historical Legacies	Role of power	Implications for future trajectories
Trajectories of change in Solomon Island Communities	<ul style="list-style-type: none"> Limited access to financial capital greatly limited the extent to which income generation activities were possible; Access to low lying fertile land in some communities limited economic activity. 	<ul style="list-style-type: none"> There are tensions between two primary discourses: monetary prosperity and that which promotes collective actions (e.g. to maintain community cohesion); These social attractors promote various actions: planting of cash crops and actions aiming to promote community cohesion (such as establishing community based organisations); The interplay of actions and discourses continually shape development paths. 	<ul style="list-style-type: none"> Trajectories are towards increased use or consumption of local resources, stress, loss of social cohesion, and reduction in capacity of the ecological system to maintain ecosystem services; Increasing inequality; Capacity of the environment to maintaining ecosystem services is rapidly declining; Neoliberal approaches to development are likely to enhance many of the negative aspects of change; Increasing tendency for individualistic ways of living erode traditional values of care, sharing, and dialogue and hence capacity for more sustainable forms of adaptation.
Responses to change in Canadian Forest-dependent communities	<ul style="list-style-type: none"> Historical economic legacies informed local cultural patterns (e.g. mill-centric), which in turn informed the types of adaptive pathways used by the community following the mill closures At household scales, gender role legacies were less resilient allowing for broader range of adaptive pathways. 	<ul style="list-style-type: none"> Mills acted as a social attractor around which different pathways of discourses and practices emerged; The role of men as breadwinners was lost with the end of their mill jobs, and women gained as caregivers and income providers; The social attractor of household chores changed emphasis as men took on greater range duties. 	<ul style="list-style-type: none"> Historical legacies strongly influenced present day culture norms; Future trajectories were conditioned by resilient culture legacies; Gender structures in some cases were more transformable, possibly leading to an expanded range of adaptive pathways; Power issues may be difficult to overcome, and thus may lead to maladaptive pathways.
Responses to change in Transylvania	<ul style="list-style-type: none"> Legacies of different assets reduce capacity of some groups 	<ul style="list-style-type: none"> Power in the community was closely intertwined with the extent to which different socio-ethnic 	<ul style="list-style-type: none"> Future change is uncertain; Much of the future trajectories for different socio-ethnic

	<p>to navigate different kinds of change;</p> <ul style="list-style-type: none"> • Some assets are dormant and may not appear to be important but resurface and allow some groups to navigate change successfully; • Collective and individual memory of different solutions and acceptable responses affect capacity to respond to change 	<p>groups conformed to the normative practice of a combination of subsistence activity and income generation;</p> <ul style="list-style-type: none"> • Those who managed change in innovative ways but which did not conform to normative paths were considered unfavourably. • Being able to conform depended greatly on access to land; • Access to land and social acceptance in the community was partly dependent on how long groups had been present in the community. 	<p>groups depends on their capacity to maintain access to land;</p> <ul style="list-style-type: none"> • The capacity of the poorest socio-ethnic groups to navigate change is decreasing.
Responses to changes induced by adaptation policies in Australia	<ul style="list-style-type: none"> • A culture of compensation (government as insurer of last resort) has developed and is politically difficult to change. • Decisions made for short-term political and economic reasons and based on a mechanistic worldview have led to irreversible infrastructure developments. • Infrastructure developments are associated with powerful positive feedbacks. • Private property rights are viewed/considered sacrosanct. 	<ul style="list-style-type: none"> • Maintaining status quo is a powerful attractor with developers having vested interests in the status quo and use lobbying against retreat and restrictions, and the spread of misinformation; • Oceanfront property owners are well organized and some are wealthy and connected to powerful and influential people; • Sympathetic media to vested interests used to create anti-climate change discourse; • Federal and State Governments, two powerful and influential actors, are both absent from the policy debate and have not taken on the responsibility of providing leadership or clarity about legislation. 	<ul style="list-style-type: none"> • Future trajectories are heavily dependent on past decisions and prevailing entrenched and reinforced worldviews and preferences (i.e. coastal ecosystems perceived as something that can be managed and controlled; private values prioritized above public values). • Public values of coastal ecosystems are intertwined with, but conflict and compete with, private values for coastal ecosystems (i.e., oceanfront properties privatize the hedonic values of the ocean but will lead to public values for beaches and dunes being lost as sea level rises).

Table 4

Path	Description and examples
Regional	Solomon Islands: an overarching trajectory of change for the region that has a particular pathway
Environmental/Societal	Australia: Different pathways of development that were not aligned with pathways of sea level rise
Values/Worldviews/Interests	Australia: Different pathways of worldviews and interests that were changing through time and affecting the nature of responses to change.
Communities	Canada: Different historically based pathways and cultures that had created different attitudes and capacities of communities as a whole to respond to change, resulting in different trajectories for different communities (e.g. in extent of engagement with new modes of employment).
Socio-ethnic groupings	Solomon Islands: Increasing inequalities emerging that were beginning to shape different ways in which people were responding; Transylvania: Different socio-ethnic groups had different change and response dynamics through time; connected to the assets they had access to or were able to accumulate.
Household	Canada: Some households had different socio-economic pathways than others.
Individual	Canada: Differences in the pathways of gender (e.g. who became the primary breadwinner and who contributed to domestic chores), which changed following mill-closure in some households
Assets	Transylvania: Assets held by different socio-ethnic groups. These assets had different patterns through time (pathways) depending on how socio-political change enabled groups to accumulate or lose those assets. Assets included: Land, Social capital (intragroup, bridging), Social capital (intergroup, linking), Ethnic Symbolic capital Political capital, Cash inflow, Human capital (agriculture), Human capital (formal education).

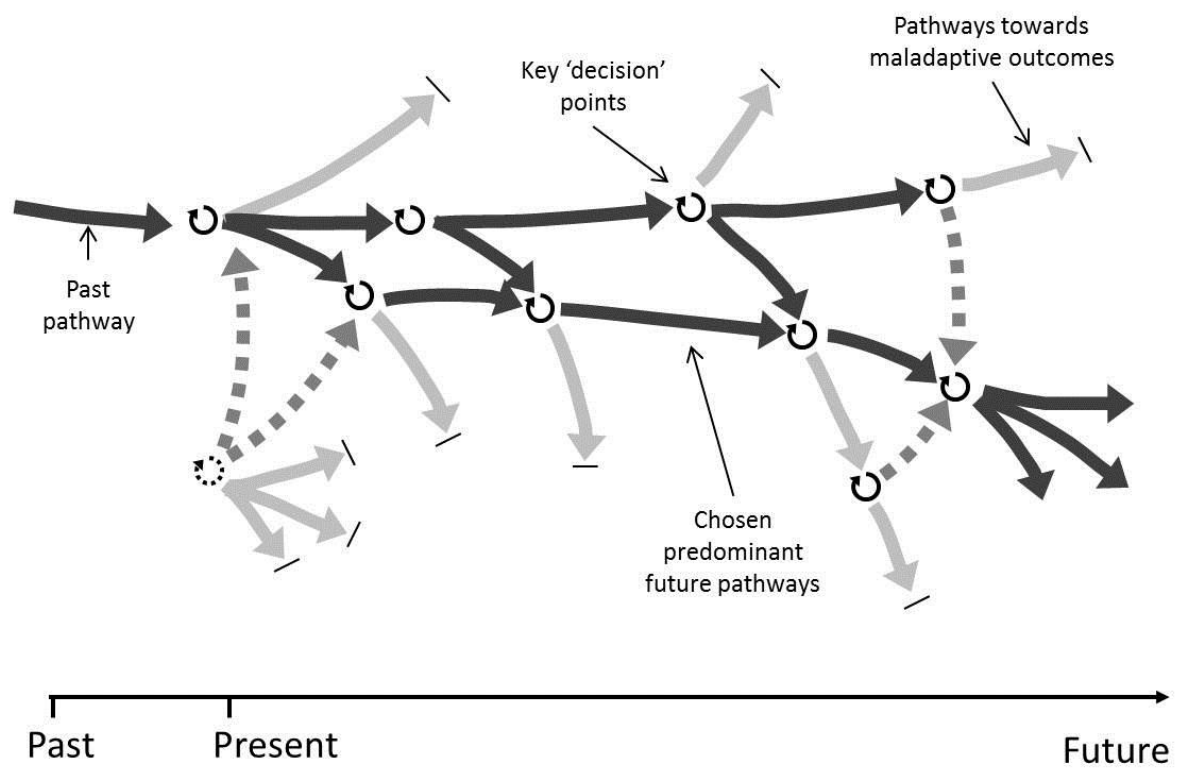


Figure 1

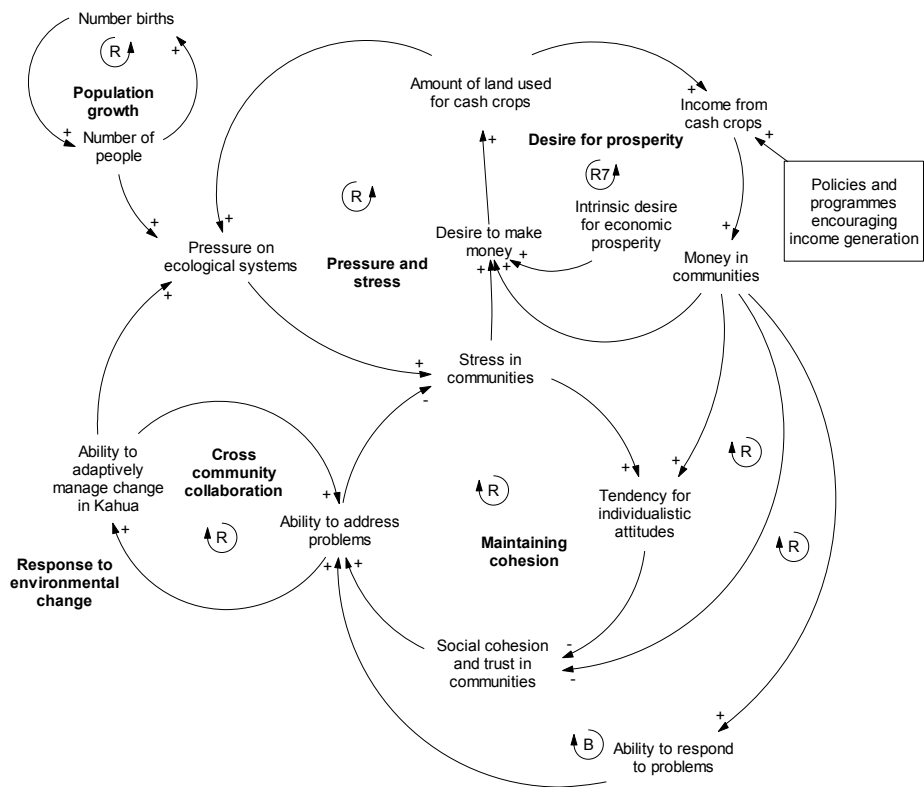


Figure 2:

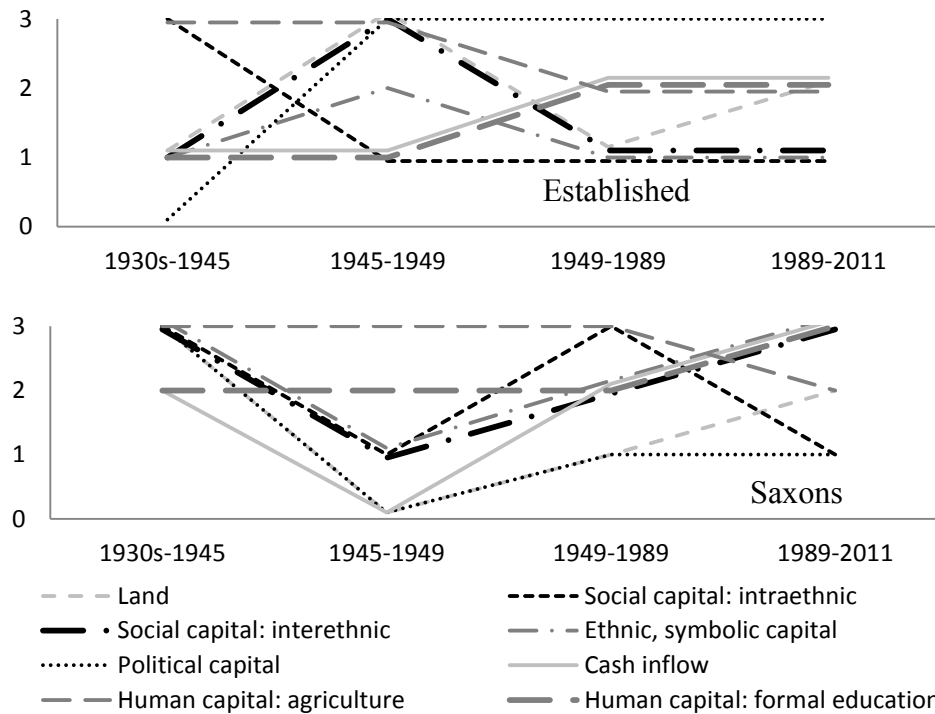


Fig 3

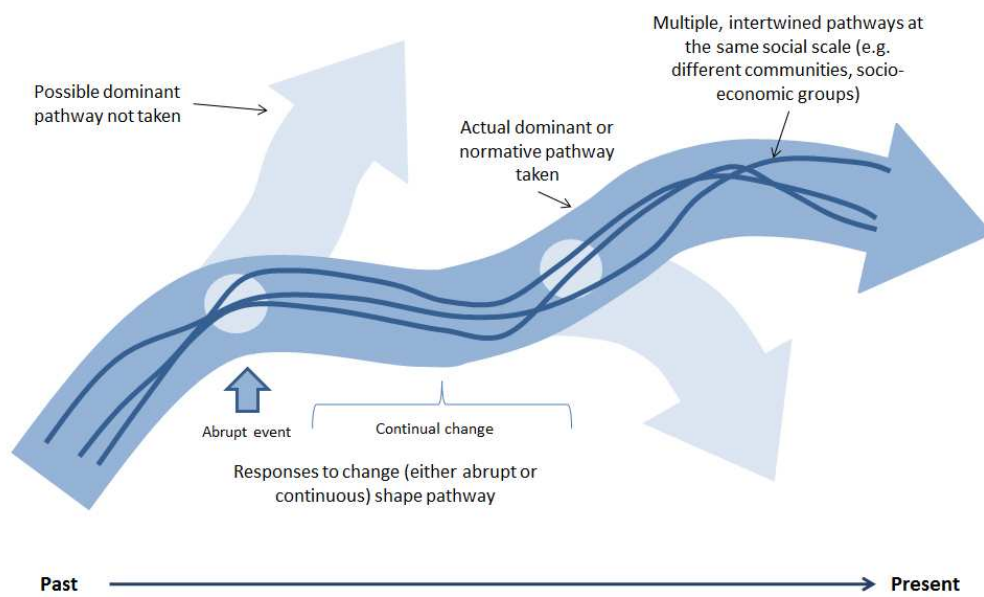


Fig 4

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